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RED BAND NEEDLE BLIGHT OF PINE ON THE CLEARWATER NATIONAL FOREST IDAHO

by

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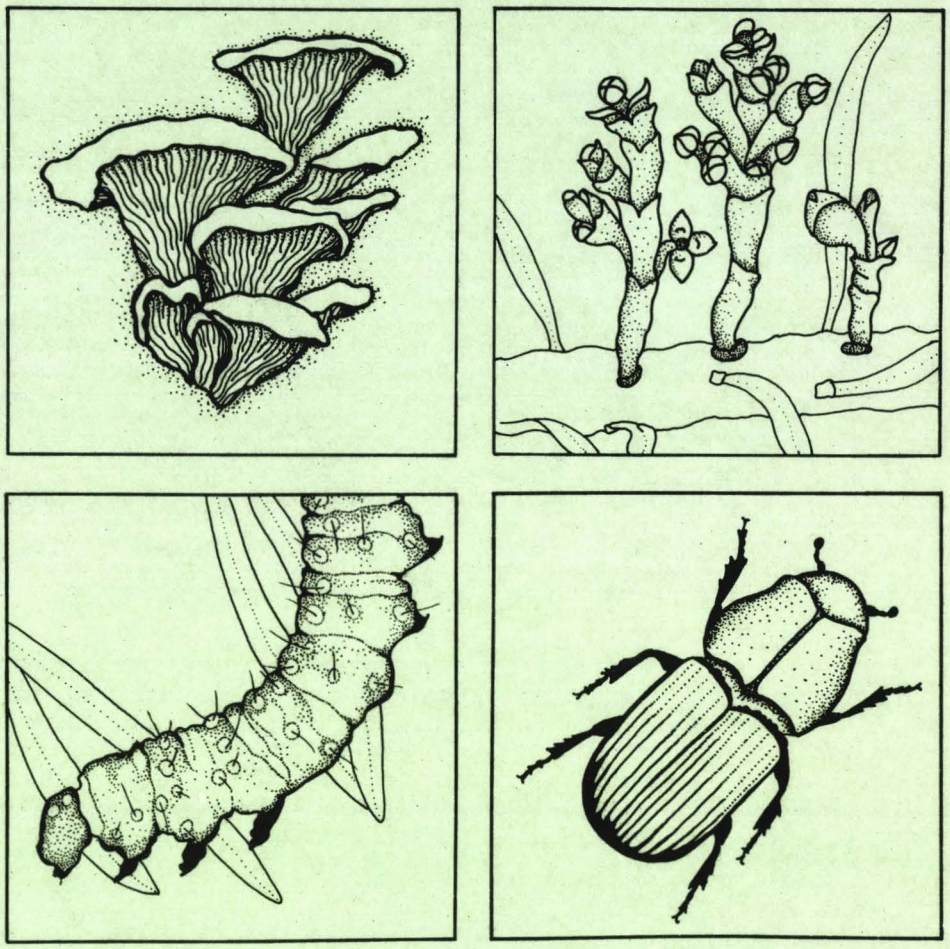

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RED BAND NEEDLE BLIGHT OF PINE ON THE CLEARWATER NATIONAL FOREST, IDAHO

by

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ABSTRACT

Red band needle blight caused by the fungus Dothistroma pini was especially severe during 1981 along portions of the Lochsa River drainage within the Clearwater National Forest. The disease was most severe on young ponderosa pine within the Wilderness Gateway Campground and adjacent Lochsa Historical Ranger Station. Western white pine and lodgepole pine were also affected. Laboratory examinations confirmed D. pini var. linearis as the major associated fungus. Outbreaks were likely associated with extended periods of cool, wet weather during the spring when infection occurred. Control options and prognosis for future impacts are discussed.

INTRODUCTION

Red band needle blight caused by the fungus Dothistroma pini Hulb. (=Scirrhia pini Funk and A. K. Parker) has occurred periodically in northern Idaho, particularly along the Lochsa drainage of the Clearwater National Forest. The first report of the fungus in the area was in 1972 when it was located on young ponderosa pine (Pinus ponderosa Laws.) in the lower Lochsa River and Priest River areas of northern Idaho (5). Subsequent reports (4,26,34) indicated the cyclical nature of the disease; high disease levels were associated with conducive spring weather. Major concentrations of the disease have remained in the Lochsa and Priest River drainages.

Infection levels and associated needle necrosis and abscission have been especially high along the Lochsa River the last two years. The disease caused dramatic visual effects along heavily traveled Highway 12, within the Wilderness Gateway Campground and adjacent Lochsa Historical Ranger Station (figure 1). Forest managers were concerned about possible impacts of the disease, especially with regard to tree mortality and likelihood of recovery of heavily infected trees. A field evaluation of the disease was conducted to help answer these questions. The following discussion focuses on the disease cycle and control options. Extensive use of the literature from the central United States and several foreign countries has been made because of the large amount of research done in these areas. A discussion of taxonomy and descriptions of the causal fungus is included in the appendix.

DISEASE CYCLE

The red band needle blight fungus has both sexual and asexual stages. The sexual stage (Scirrhia) is rare; role of spores produced during this stage is unknown. The asexual form (Dothistroma) of the fungus is common and is responsible for the rapid buildup of the disease (24).

Conidia (asexual spores) are borne in fruiting bodies called stromata, which develop below the epidermis of infected needles. Stromata develop during the year following infection and usually mature and produce conidia the following spring. Conidia are exposed as the host epidermis is split following stromatal maturity. Spores are released during wet weather and dispersed by rainsplash throughout the growing season. Long distance spore dissemination by wind is not common (23). Infection can occur throughout the spring and summer when sufficient rainfall occurs. Conidia infect needles by penetration of stromata (21). Previous seasons' needle infection can occur in the spring, whereas current year's needles probably aren't infected until midsummer (23). Two growing seasons are required for completion of the life cycle in most areas of North America (24); however, along the West Coast the cycle may be completed in one year (3,25). Length of the life cycle in Idaho is unknown, but is possibly two years.

Initial disease symptoms develop on infected needles in the fall of the year of infection. These symptoms consist of yellow and tan spots and bands that appear water soaked. Spots and bands eventually turn brown to reddish brown. Reddish bands are more distinct on ponderosa pine (figure 2) than lodgepole pine (P. contorta Dougl.) (figure 3) or western white pine (P. monticola Dougl.). As the disease progresses, distal ends of infected needles commonly become chlorotic, then necrotic, with the base of needles remaining green. Needles may develop extensive chlorosis in a few weeks following first appearance of symptoms (24).

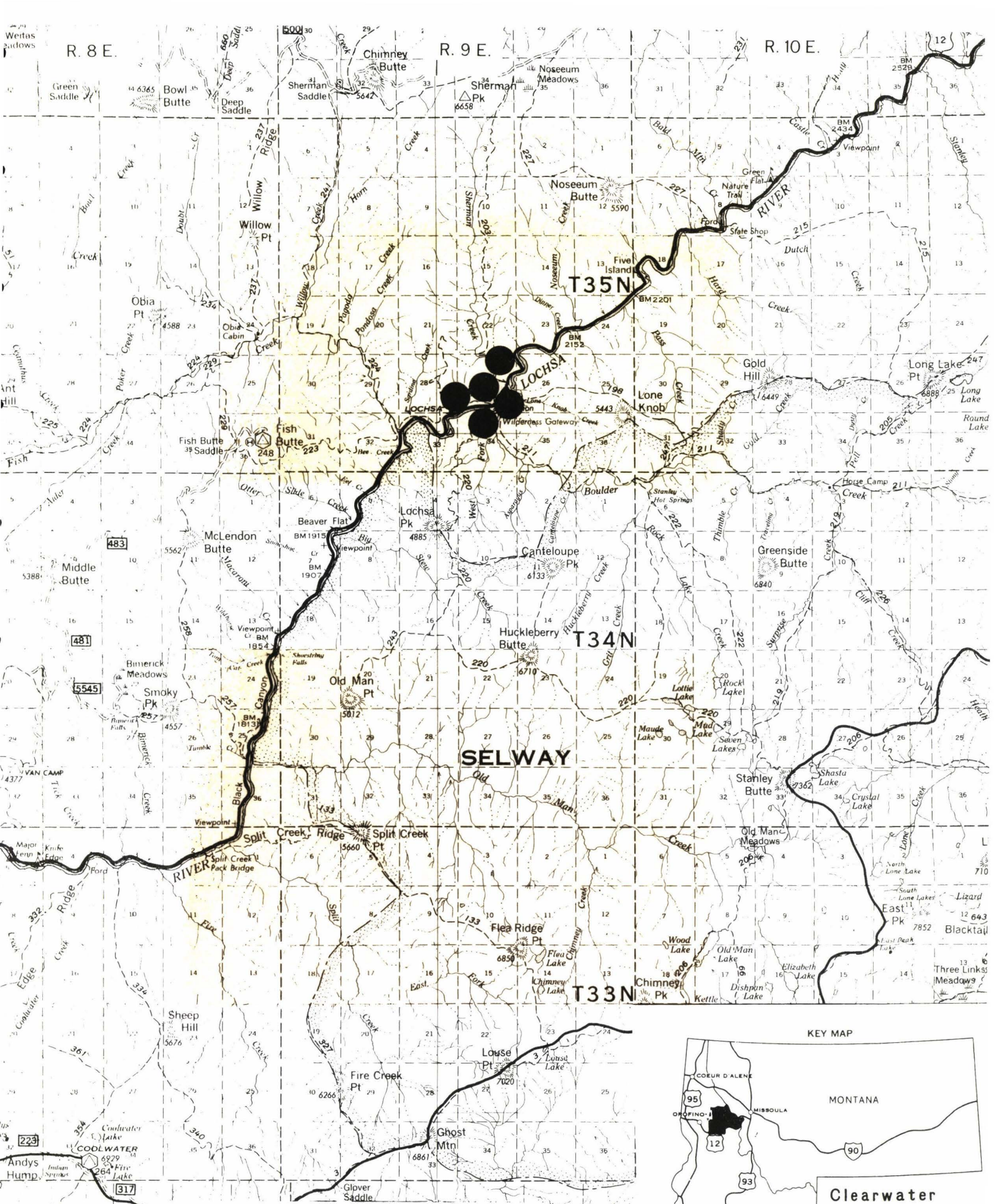

Figure 1.--Areas evaluated (●) for red band needle blight within the Clearwater National Forest.

Figure 2.--Red band needle blight symptoms on ponderosa pine. Red bands occur on infected needles; needle necrosis extends from the tips while the base of needles remain green.

Figure 3.--Dothistroma pini on lodgepole pine. Bands are yellow to yellow-brown rather than reddish brown. Necrosis begins at the tips and develops toward the base of needles.

Infected needles usually drop prematurely. Needles may be cast in late fall of the year following infection or may not fall until a year later.

Disease severity is usually greater in the lower part of the crown (15) (figure 4). As the disease progresses, the fungus spreads via rainsplash and symptoms progress up through the crown (2).

Figure 4.--Pattern of crown infection by Dothistroma pini on ponderosa pine. Symptoms progress from the bottom of the crown upward and from the inside out.

The disease often causes a reduction in growth rate (14). Studies on P. radiata (2, 35) indicate that reductions in diameter growth only occur after defoliation has exceeded 25 percent. With defoliation in excess of 75 percent, growth is about one-tenth of that of a healthy tree. Defoliation generally causes greater reductions in diameter than in height growth (12).

Mortality of trees infected with D. pini is usually infrequent (13, 14, 22). Young trees may be killed (7, 11) but as trees mature they usually become more resistant (13, 14). Trees infected with red band needle blight may be more susceptible to secondary organisms which may hasten mortality (9, 15). Root diseases were frequently found on trees within the Wilderness Gateway Campground; mortality rates may accelerate due to action of both diseases together.

CONTROL

Most efforts to control red band needle blight have involved application of fungicides to protect pine foliage from infection. Successful application schedules have been developed for ornamental and windbreak pines in the central United States (21, 24) and on pine crops in New Zealand and East Africa (14). Spray schedules have not been developed for the disease in the western United States because of differences in the life history of the fungus and lack of research in the area.

Probably the first attempt at practical control was in 1954 when Bordeaux mixture (copper sulfate and hydrated lime) was shown to be effective against the disease (32). Several later investigations (8, 12, 16, 21) showed that copper fungicides were also effective. In the central United States two fungicide applications during the growing season provided good control in shelterbelt and ornamental plantings (24). The first application in about mid-May protects previous season's needles; the second application protects current year needles. When controlling the disease in Austrian and ponderosa pines, the second application can be made in early to midsummer since current year needles of these species are initially resistant to infection and do not become susceptible until midsummer (21, 24).

Application of copper fungicides to control the disease within large plantations was initially developed for East Africa and has been used operationally in New Zealand (14). Field treatments were initiated in New Zealand during 1965 on young pine plantations (1). Since Pinus radiata becomes resistant to the disease after 15 years of age, annual treatments are needed only until trees reach that age. All fungicide applications have been made by aircraft. This may be the only example of successful widespread application of fungicides to control a forest disease in the field.

Several other fungicides have been tested against D. pini. Benomyl formulations and chlorothalonil are similar to copper fungicides in effectiveness (8, 16). These organic chemicals have not been widely used against red band needle blight.

The other major approach to controlling this disease is developing resistance in susceptible pine species and favoring nonsusceptible conifers in areas of high disease incidence. For P. radiata no evidence of complete resistance has yet been found. However, individual trees showing early development of mature plant resistance have been selected and propagated in East Africa (14). Evaluation of resistance of other tree species has not been made. Ponderosa pine generally remains susceptible to the disease throughout its life, although damage is most severe on young trees (24). Although levels of resistance of western white pine and lodgepole pine are unknown, we would suspect some intraspecific resistance because of the general low disease levels in these species. Nonsusceptible conifers such as Douglas-fir (Pseudotsuga menziesii Franco) and western larch (Larix occidentalis Nutt.) can be favored on sites where they are suited and disease levels in the pine are high.

CONCLUSIONS

1. Red band needle blight has been common for a number of years in portions of northern Idaho and especially within the Clearwater National Forest along the Lochsa River. Current epidemic disease levels are due to conducive weather conditions for infection and buildup of the pathogens that have occurred during the last two growing seasons. Several areas of high disease incidence contain a large proportion of young ponderosa pine which are especially susceptible. The disease is not restricted to planted pines, but common on native trees throughout several locations along the Lochsa drainage. Areas of concentrated damage occur within and adjacent to the Wilderness Gateway Campground (figure 1); symptomatic pines extend above and below this area.

2. Major impact of the disease is probably growth reduction resulting from severe defoliation. Several of the trees examined had greater than 75 percent defoliation from this disease. However, mortality due to the disease is not yet apparent on the sites evaluated. Unless several more years of extensive infection occurs, we would expect mortality from the disease to be minimal.

3. Role of red band needle blight in predisposing heavily infected trees to other biotic factors causing tree mortality is unknown in Idaho. We may expect some scattered pine mortality in Wilderness Gateway Campground because of severe needle blight and presence of root disease caused by Armillaria mellea (Vahl. ex Fr.). However, losses are not expected to be extensive.

4. We expect many of the blighted trees to recover over the next few years. Inoculum levels will remain high; however, infection will depend on moisture conditions during the growing season. Cool, wet spring weather for extended periods will favor continued disease development. We expect some defoliation next year because of the lag time between infection and symptom expression.

5. Chemical control is not currently recommended in any of the areas evaluated. We do not know enough about infection biology in northern Idaho to predict when applications should be made. In addition, no chemicals are currently registered for this disease in Idaho.

6. Individual tree resistance will likely become apparent during the course of disease epidemics. Some ponderosa pine in areas of severe disease have apparently escaped infection; such escapes may be due to resistance. Disease levels in western white pine and lodgepole pine are low in comparison to ponderosa pine. These less susceptible pines and other nonsusceptible conifers should be favored in areas of concentrated disease.

7. If losses to planted ponderosa pine become extensive within Wilderness Gateway Campground, other conifers such as Douglas-fir should be used to replace diseased pines.

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APPENDIX

TAXONOMY AND DESCRIPTION OF THE FUNGUS

Taxonomy of the causal fungus of red band needle blight has been in a confused state for some time and many mycologists still disagree on the correct nomenclature (13). The earliest record of the fungus was probably made by Doroguin in 1911 and 1912 when he described cause of the disease as Cytosporina septospora (6). The next record of the red band fungus was made by Saccardo in 1920, who described it as Actinothyrium marginatum from collections of diseased pine foliage from Idaho (27). Validity of this taxon was subsequently questioned (31). Saccardo's material was later identified as belonging to Lecanosticta acicola (Thum.), a common pathogen of western white pine in Idaho (28). Siggers (30) examined a range of material that had been called L. acicola, Septoria acicola, and A. marginatum, and concluded that all corresponded most closely to Dothistroma pini, a fungus described by Hulbary in 1943 from collections of Austrian pine in Illinois (10).

Initial investigation of the disease on Pinus radiata (D. Don) in East Africa referred to the causal organism as A. marginatum (10); the name was subsequently changed to D. pini (11). Recent attempts at revision of the genus have suggested other specific epithets such as D. acicola (Thum.) (29) and D. septospora (Dor.) (19). However, D. pini has generally remained the accepted name for the fungus.

Three varieties of D. pini have been described. The first two were proposed by Thyr and Shaw in 1964 (33) as a variety pini based on Hulbary's type material and collections from Illinois, Kansas, and Kentucky, and variety linearis based on the type material of A. marginatum and collections from Idaho and Montana. Additional work in Africa (18) resulted in proposal of a third variety, keniensis, which described strains intermediate between pini and linearis. Varietal descriptions are based primarily on conidial length (24, 33). The longest conidia are from variety linearis (western U.S.), whereas the shortest conidia are from variety pini (central and eastern U.S.); variety keniensis (Africa) describes a variety with spores of intermediate length.

Isolates obtained from recent collections of ponderosa pine, western white pine and lodgepole pine from the Clearwater National Forest seemed to fit the description of D. pini var. linearis. Conidia were mostly 2-5 celled, slightly curved, rounded at the ends, and measured approximately 2-3μ by 28-38μ (figure 5). Spore producing stromata were black, erumpent through host epidermis, and mostly produced within necrotic red bands on infected needles.

Figure 5.--Photomicrograph of conidia of Dothistroma pini. Conidia are hyaline, slightly curved, 2-5 celled, and measure approximately 2-3μ by 28-38μ.